DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention is based on the electron-injection material for the organic (electroluminescence EL) elements used for the flat-surface light source or a luminescence display and high brightness, and a long lasting light emitting device.

[0002]

[Description of the Prior Art] Promising ** of the use as a large area full color display device with a cheap solid-state luminescence type is carried out, and, as for the EL element which used the organic substance, many development is performed. Generally the EL element consists of counterelectrodes of the couple the luminous layer and whose layer of this were pinched. Luminescence is a phenomenon which emits energy as a light, in case an electron will be poured in from a cathode side, an electron hole will be poured in from an anode plate side, an electron and an electron hole will recombine in a luminous layer and an energy level will return from a conduction band to a valence band, if electric field are impressed between two electrodes.

[0003] Compared with the inorganic EL element, the conventional organic EL element had high driver voltage, and luminescence brightness and its luminous efficiency were also low. Moreover, property degradation had not resulted in utilization remarkably, either. In recent years, the organic EL element which carried out the laminating of the thin film containing the organic compound with the high fluorescence quantum efficiency which emits light by the low battery not more than 10V is reported, and the interest is attracted (refer to applied FIJIKUSU Letters, 51 volumes, 913 pages, and 1987). This method used the metal chelate complex as the fluorescent substance layer, and used the amine compound as the hole-injection layer, the laminating was carried out, green luminescence of high brightness has been obtained, under the direct current voltage of 6-7V, brightness is several 100 (cd/m2), the maximum luminous efficiency is 1.5 (lm/W), and the performance near a practical use field is attained.

[0004] however, the organic EL element by present is not yet enough, although luminescence brightness is improved by the improvement of structure -- there is nothing Moreover, it has the big problem of being inferior to the stability at the time of repeat use. This has chemically unstable metal complexes, such as for example, a tris(8-hydroxyquinolinate)aluminium complex, at the time of an electroluminescence, adhesion with cathode is also bad, and, as for the problem, element degradation is not solved, either. Thus, luminescence brightness and luminous efficiency are high, there is no luminescent material which has a stable luminescence property over a long time, and development of luminescent material is desired now.

[0005] The hole-injection material of the organic layer of an organic EL element has the good hole-injection efficiency from an anode plate, and it is desirable that it is the material which can convey the poured-in electron hole in the direction of a luminous layer efficiently. For that purpose, ionization potential is small, hole mobility is large, and to excel in stability is demanded. As an electron-injection material, the electron-injection efficiency from cathode is good, and it is desirable that it is the material which can convey the poured-in electron in the direction of a luminous layer efficiently. For that purpose, an electron affinity is large, electron mobility is large, and to excel in stability is demanded.

[0006] As a hole-injection material proposed by present, it is an OKISA diazole derivative (U.S. Pat. No. 3,189,447). an oxazole derivative (U.S. Pat. No. 3,257,203) and a hydrazone derivative (U.S. Pat. No. 3,717,462 --) JP,54-59,143,A, U.S. Pat. No. 4,150,978, a triaryl pyrazoline derivative (U.S. Pat. No. 3,820,989 --) JP,51-93,224,A, JP,55-108,667,A, and an arylamine derivative (U.S. Pat. No. 3,180,730 --) There are U.S. Pat. No. 4,232,103, JP,55-144,250,A, JP,56-119,132,A, a stilbene derivative (JP,58-190,953,A, JP,59-195,658,A), etc.

[0007] as electron-injection material -- an OKISA diazole derivative (JP,2-216791,A) and a peri -- non, although there were a derivative (JP,2-289676,A), a perylene derivative (JP,2-189890,A, JP,3-791,A), a Quinacridone derivative (JP,6-330031,A), etc., the electron-injection property from the cathode of the organic EL element which used this electron-injection material to an organic layer was not enough

[0008] Although luminous efficiency is improved when the organic EL element by present improves composition, it does not have still sufficient element life. Especially, the injection efficiency by contact of a cathode metal and an organic layer interface is low, and the thermal resistance of the organic layer in contact with the electrode etc. has been a big problem. Therefore, development of the organic material for development of a long lasting organic EL element with good luminescence properties, such as luminous efficiency and luminescence brightness, is desired.

[0009]

[Problem(s) to be Solved by the Invention] By organic electroluminescent-element material with a good luminescence property, this invention is good, it is high brightness and quantity luminous efficiency, and offering a few reliable

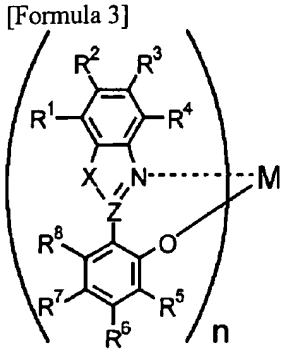
electroluminescent-element material has luminescence degradation, and the electron-injection efficiency from cathode aims for it to let it offer the high brightness which used an organic electroluminescent-element material of this invention further, and a long lasting organic EL element. As a result of this invention persons' inquiring wholeheartedly, it found out that the organic EL element which used at least a kind of organic electroluminescent-element material shown by the general formula [1] had a luminescence property and a good electron-injection property, and the stability of a luminescence life was also excellent in it, and resulted in this invention.

[0010]

[Means for Solving the Problem] That is, this invention relates to an organic electroluminescent-element material shown by the following general formula [1].

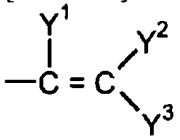
General formula [1]

[Formula 3]



[-- the substituent general formula [2] in which X expresses -O-, -S-, >N-R9, and >CR10 (R11) among a formula, and R1-R11 are independently shown by the following general formula [2], respectively

[Formula 4]



the inside of a formula, Y1, Y2, and Y3 -- the alkyl group which is not replaced [a hydrogen atom, a cyano group, substitution, or] -- the heterocycle machine which is not replaced [the aryl group which is not replaced / the cycloalkyl machine which is not replaced / substitution or /, substitution, or /, substitution, or] -- expressing -- Y2 It may join together mutually and Y 3 may form the ring which may contain an oxygen atom, a sulfur atom, or a nitrogen atom. A hydrogen atom, a halogen atom, a cyano group, a nitro group, a hydroxyl group, a siloxy machine, The alkyl group which is not replaced [an acyl group, a carboxylic-acid machine a sulfonic group, substitution or], The alkyl thio machine which is not replaced [the alkoxy group which is not replaced / substitution or /, substitution, or], The aryl group which is not replaced [the amino group which is not replaced / substitution or /, substitution, or], The heterocycle machine which is not replaced [the aryl thio machine which is not replaced / the aryloxy group which is not replaced / the cycloalkyl machine which is not replaced / substitution or /, substitution, or /, substitution, or /, substitution or] is expressed, and it is R1 -R8. At least one is the substituent shown by the general formula [2]. R1 -R8 You may form the ring in which adjoining substituents may join together mutually and they may contain an oxygen atom, a sulfur atom, or a nitrogen atom. Z expresses a carbon atom or a nitrogen atom. M expresses a divalent or tetravalent metal atom, and n expresses the positive integer of 2-4.]

[0011] Furthermore, this invention is organic electroluminescent element which is the layer in which a monostromatic contains the above-mentioned organic electroluminescent-element material at least in the organic electroluminescent element equipped with the organic compound thin film layer which contains a luminous layer in inter-electrode [of a couple].

[0012] Furthermore, this invention is organic electroluminescent element which is the layer in which a luminous layer contains the above-mentioned organic electroluminescent-element material.

[0013] Furthermore, this invention is organic electroluminescent element which is the layer between a luminous layer and cathode in which a monostromatic contains the above-mentioned organic electroluminescent-element material at least.

[Embodiments of the Invention]

[0014] The substituent of R1 -R11 of the compound shown by this invention is explained. There are a fluorine, chlorine, a bromine, and iodine as an example of a halogen atom. As an example of an alkyl group, carbon numbers 1-20 are desirable, and there are a methyl group, an ethyl group, a propyl group, a butyl, a sec-butyl, a tert-butyl, a pentyl machine, a hexyl machine, a heptyl machine, an octyl machine, a stearyl machine, a TORIKURORO methyl group, a TORIFURORO methyl group, 2 and 2, 2-truffe RUORO ethyl group, 2, 2 and 3, 3-tetrafluoro propyl group, 2, 2, 3 and 3, a 3-pentafluoro As an example of an alkoxy group, carbon numbers 1-20 are desirable, and there are a methoxy machine, an ethoxy basis, a propoxy group, a butoxy machine, a TORIKURORO methoxy machine, a truffe RUORO methoxy machine, a trifluoroethoxy machine, a pentafluoro propoxy group, 2, 2 and 3, a 3-tetrafluoro propoxy group, etc. As an example of an alkyl thio machine, carbon numbers 1-20 are desirable, and there is a methylthio machine, ethyl thio machine, propyl thio machine, butyl thio machine, TORIKURORO methylthio machine,

trifluoromethyl thio machine, truffe RUORO ethyl thio machine, pentafluoro propyl thio machine, 2, 2 and 3, and 3-tetrafluoro propyl thio machine etc. As an example of the amino group, carbon numbers 1-20 are desirable, and there are the amino group, a dimethylamino machine, a diethylamino machine, a diphenylamino machine, a ditolylamino machine, an N-naphthyl-1-phenylamino machine, etc. As an example of an aryl group, carbon numbers 6-40 are desirable, and there are a phenyl group, a tolyl group, a naphthyl group, a biphenyl machine, o and m, p-terphenyl machine, an anthranil, a phenan training nil machine, a fluorenyl group, 9-phenyl anthranil, 9, 10-diphenyl anthranil, a pyrenyl machine, etc. As an example of a cycloalkyl machine, carbon numbers 4-20 are desirable, and there are a cyclopentylic group, a cyclohexyl machine, a NORUBONAN machine, an adamantane machine, a 4-methyl cyclohexyl machine, a 4-cyano cyclohexyl machine, etc. There is a basis which the above-mentioned aryl group combined through the oxygen atom as an example of an aryloxy group. There is a basis which the above-mentioned aryl group combined through the sulfur atom as an example of an aryl thio machine. As an example of a heterocycle machine, a pyrrole machine, a pyrroline machine, a pyrazole machine, A pyrazoline machine, an imidazole group, a triazole machine, a pyridine machine, a pyridazine machine, A pyrimidine machine, a pyrazine machine, a triazine machine, the Indore machine, a pudding machine, A quinoline machine, an isoquinoline machine, a SHINORIN machine, a quinoxaline machine, a benzo quinoline machine, full -- me -- non -- a basis, a dicyano fluorene machine, a carbazol group, and an oxazole machine -- An OKISA diazole machine, a thiazole machine, a thiadiazole machine, a triazole machine, An imidazole group, a benzo oxazole machine, a benzothiazole machine, a benzotriazol machine, There are a benzimidazole machine, a screw benzo oxazole machine, a screw benzothiazole machine, a screw benzimidazole machine, an anthrone machine, a dibenzofuran machine, a dibenzo thiophene machine, an anthraquinone machine, an acridone machine, a phenothiazin machine, etc. The shape of a straight chain, the letter of branching, and annular any are sufficient as the above-mentioned substituent. Moreover, this one substituent may be introduced and may be introduced. [two or more] In the case of introduction, more than one may differ, even if mutually the same. Moreover, you may form a ring by substituents.

[0015] As an example of the substituent which may be added to the basis of the above-mentioned publication The halogen atom of a fluorine, chlorine, a bromine, and iodine, a methyl group, an ethyl group, A propyl group, a butyl, a sec-butyl, a tert-butyl, a pentyl machine, A hexyl machine, a heptyl machine, an octyl machine, a stearyl machine, a TORIKURORO methyl group, A trifluoromethyl machine, 2 and 2, 2-truffe RUORO ethyl group, 2, 2 and 3, 3-tetrafluoro propyl group, A 2, 2, 3, 3, and 3-pentafluoro propyl-group, 1, 1, 1, 3 and 3, and 3-hexafluoro-2-propyl group, The alkyl group which is not replaced substitution, such as a 2, 2, 3, 3, 4, and 4-hexafluoro butyl and 2-methoxy ethyl group, or], A methoxy machine, an n-butoxy machine, a tert-butoxy machine, a TORIKURORO methoxy machine, A trifluoroethoxy machine, a pentafluoro propoxy group, 2, 2 and 3, 3-tetrafluoro propoxy group, The alkoxy group which is not replaced [the substitution of a 1, 1, 1, 3, 3, and 3-hexafluoro-2-propoxy group, a 6-(perfluoro ethyl) hexyloxy machine, etc., or], A cyano group, a nitro group, the amino group, a methylamino machine, a diethylamino machine, An ethylamino machine, a diethylamino machine, a dipropylamino machine, a dibutylamino machine, Monochrome, such as a diphenylamino machine, or the JI substitution amino group, the screw (acetoxy methyl) amino group, The screw (acetoxy ethyl) amino group, the screw acetoxy propyl amino group, The acylamino machines, such as a screw (acetoxy butyl) amino group, a hydroxyl group, a siloxy machine, An acyl group, a methyl carbamoyl group, a dimethyl carbamoyl group, an ethyl carbamoyl group, There are carbamoyl groups, such as a diethylcarbamoyl machine, a PUROI pill carbamoyl group, a butyl carbamoyl group, and a phenylcarbamoyl machine, a carboxylic-acid machine, a sulfonic acid group, an imido basis, a cyano group, a nitro group, etc. Moreover, the aryl group of the above-mentioned publication, a cycloalkyl machine, an aryloxy group, an aryl thio machine, a heterocycle machine, etc. may be substituents.

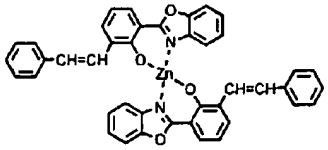
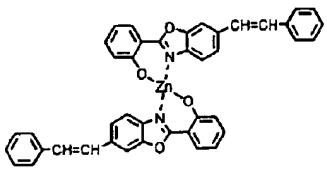
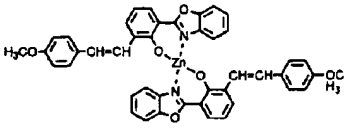
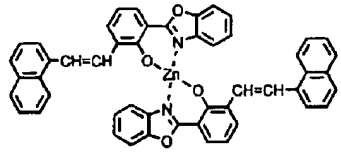
[0016] Moreover, Y1 -Y3 Although chosen as a basis and a substituent from the above-mentioned basis and substituent which were indicated by R1 -R11, and the same basis, it is not restricted to these.

[0017] Moreover, in a general formula [1], although a metal atom desirable as M shows metal atoms of 2 - tetravalence such as beryllium, zinc, cadmium, magnesium, calcium, cobalt, nickel, iron, copper, platinum, palladium, tin, strontium, a scandium, aluminum, a gallium, an indium, a zirconium, silicon, and germanium, it is not restricted to these. n changes with valences of a metal atom and, in the case of divalent metal, in the case of 2 and trivalent metal, is 4 in the case of 3 and a quadrivalent metal.

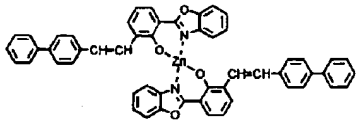
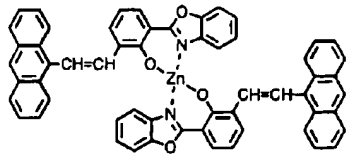
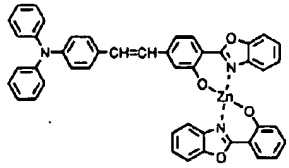
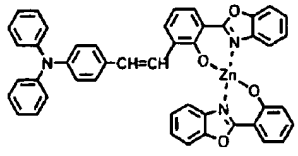
[0018] Although the example of representation of the compound of the general formula [1] used for below by the organic EL element of this invention is illustrated concretely, this invention is not restricted to the following examples of representation.

[0019]

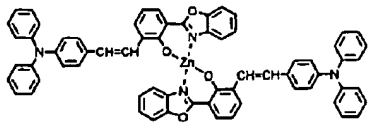
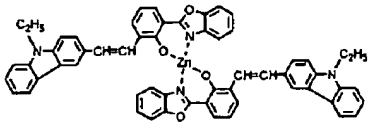
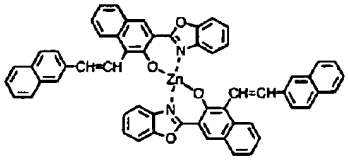
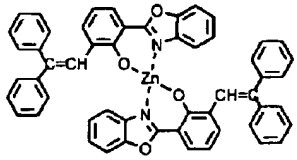
[Table 1]

No.	化学構造
1	
2	
3	
4	

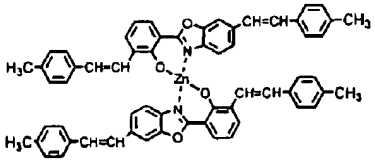
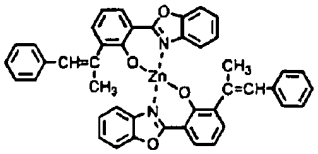
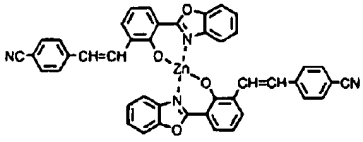
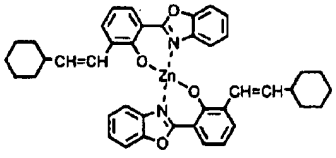
[0020]

No.	化学構造
5	
6	
7	
8	

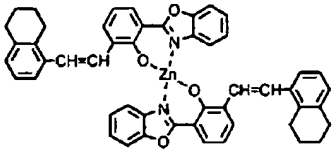
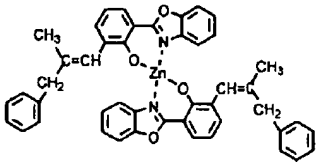
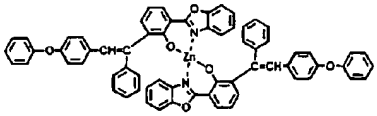
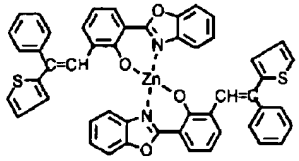
[0021]

No.	化学構造
9	
10	
11	
12	

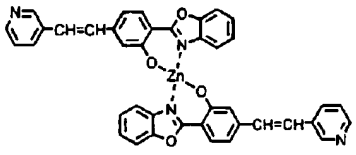
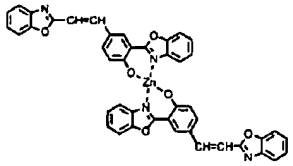
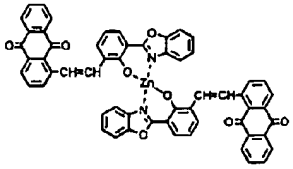
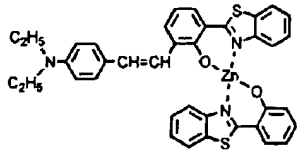
[0022]

No.	化学構造
13	
14	
15	
16	

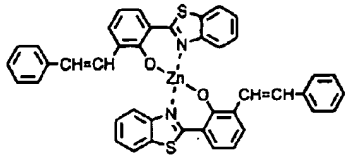
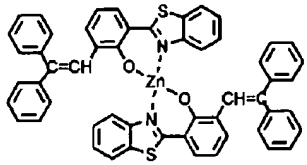
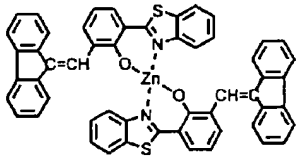
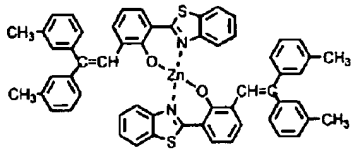
[0023]

No.	化学構造
17	
18	
19	
20	

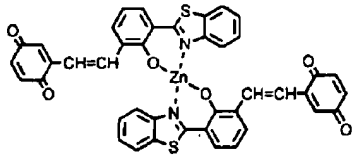
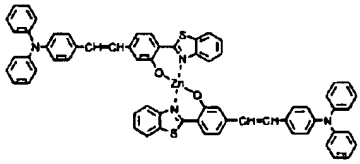
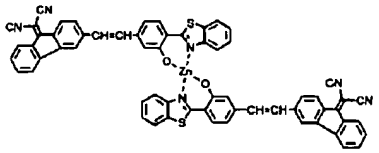
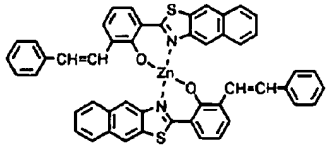
[0024]

No.	化学構造
21	
22	
23	
24	

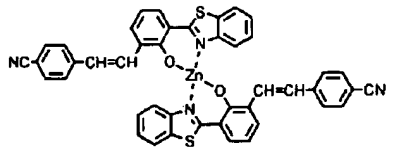
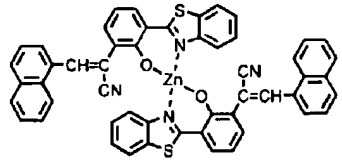
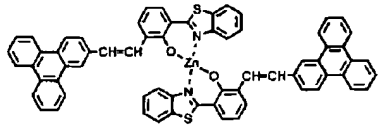
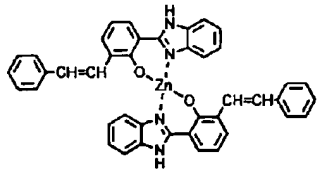
[0025]

No.	化学構造
25	
26	
27	
28	

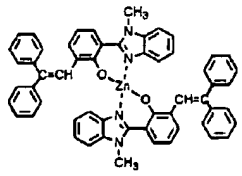
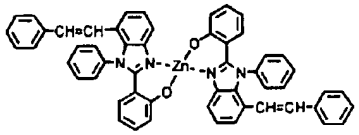
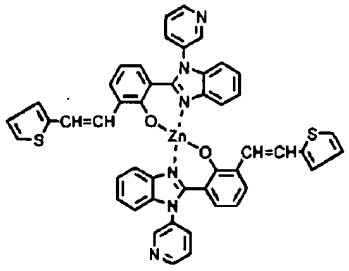
[0026]

No.	化学構造
29	
30	
31	
32	

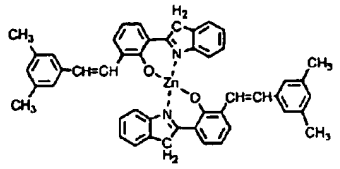
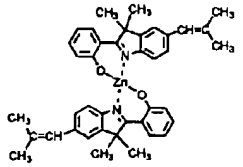
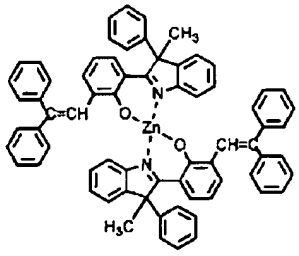
[0027]

No.	化学構造
33	
34	
35	
36	

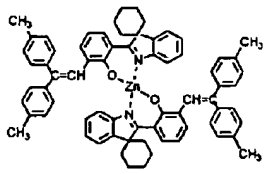
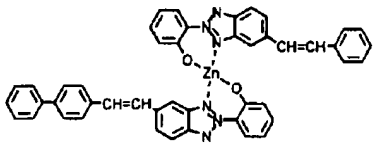
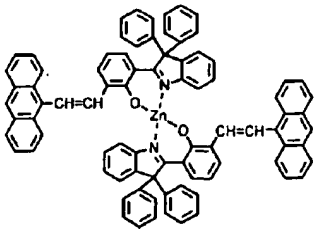
[0028]

No.	化学構造
37	
38	
39	

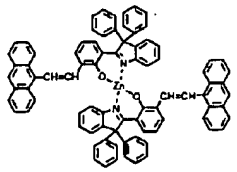
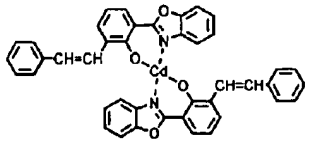
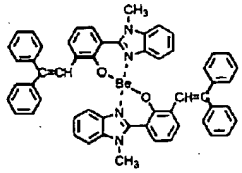
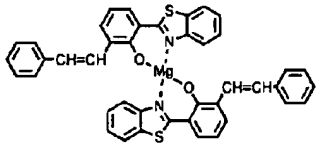
[0029]

No.	化学構造
40	
41	
42	

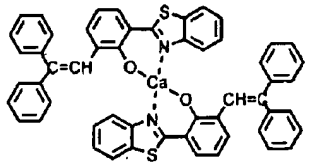
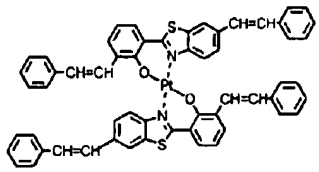
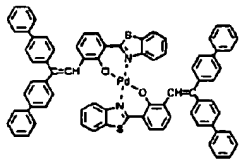
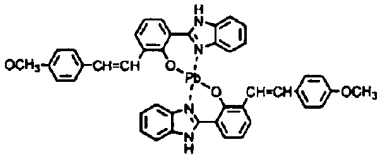
[0030]

No.	化学構造
43	
44	
45	

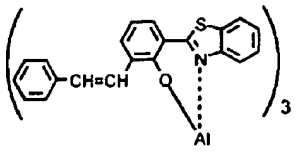
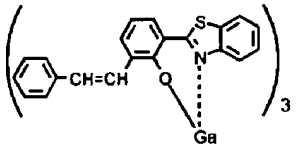
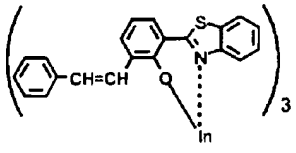
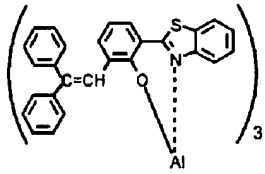
[0031]

No.	化　学　構　造
46	
47	
48	
49	

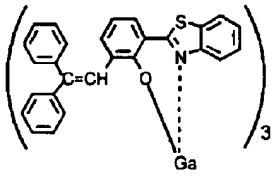
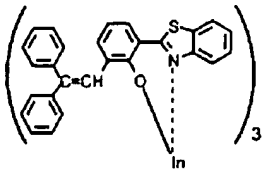
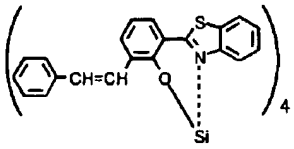
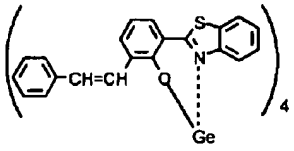
[0032]

No.	化　学　構　造
50	
51	
52	
53	

[0033]

No.	化学構造
54	
55	
56	
57	

[0034]

No.	化学構造
58	
59	
60	
61	

[0035] The compound shown by the general formula [1] of this invention can be used as luminescent material or an electron-injection material, and even if it uses independently within the same layer, it may mix and it may be used, respectively. Moreover, if there is need, even if it will use it, mixing with other luminescent material, an electron hole, or an electron-injection

nature compound, it does not interfere. Since the electron-injection nature and the luminescence property from electronic transport capacity and cathode are good, the compound of this invention can be used very effective in the luminous layer or electron-injection layer of an organic EL element.

[0036] An organic EL element is an element in which the monostromatic or the multilayer organic thin film was formed between an anode plate and cathode. In the case of the mold, the luminous layer is further prepared between an anode plate and cathode. A luminous layer contains luminescent material, and in order to make the electron poured in from the electron hole which was poured in from the anode plate in addition to it, or cathode convey to luminescent material, it may contain hole-injection material or electron-injection material. Luminescent material may have electron hole transportability or electronic transportability. Although a multilayer type has the organic EL element which carried out the laminating with multilayer (anode plate / hole-injection layer / luminous layer / electron-injection layer / cathode) composition, such as (an anode plate / hole-injection layer / luminous layer / cathode), and (an anode plate / luminous layer / electron-injection layer / cathode), it is not restricted to these.

[0037] In the case of the organic thin film two-layer structure by which the laminating was carried out in the order of (an anode plate / hole-injection layer / luminous layer / cathode), the luminous layer and the hole-injection layer are separated. According to this structure, the hole-injection efficiency from a hole-injection layer to a luminous layer can improve, and luminescence brightness and luminous efficiency can be increased. In this case, it is desirable that the luminescent material itself used for a luminous layer is electronic transportability or to add electron-injection material in a luminous layer. In the case of the organic thin film two-layer structure by which the laminating was carried out in the order of (an anode plate / luminous layer / electron-injection layer / cathode), the luminous layer and the electron-injection layer are separated. According to this structure, since the electron-injection efficiency from an electron-injection layer to a luminous layer improves, luminescence brightness and luminous efficiency can be raised. In this case, it is desirable that the luminescent material itself used for a luminous layer is electron hole transportability or to add hole-injection material in a luminous layer.

[0038] Moreover, in the case of organic thin film 3 layer structure, it has a luminous layer, a hole-injection layer, and an electron-injection layer, and it is raising the efficiency of the electron hole in a luminous layer, and electronic reunion. Thus, an organic EL element can be made into multilayer structure, and the fall of the brightness by quenching or a life can be prevented. Moreover, a hole-injection layer, a luminous layer, and an electron-injection layer may be formed of the layer more than a bilayer, respectively. There are many examples which call a hole-injection layer and the layer between the hole-injection layer and luminous layer electron hole transporting bed for the layer which is in contact with the anode plate when a hole-injection layer is more than a bilayer, and call an electron-injection layer and the layer between the electron-injection layer and luminous layer electronic transporting bed for the layer which is in contact with cathode when an electron-injection layer is more than a bilayer. In the case of such multilayer structure, an organic thin film becomes the structure of four or more layers in many cases.

[0039] In a luminous layer and an electron-injection layer, if the organic EL element of this invention has the need, in addition to the compound of a general formula [1], it can use a well-known luminescent material, doping material, hole-injection material, and electron-injection material.

[0040] The following compounds are mentioned as the luminescent material or doping material of a luminous layer of the organic EL element which used the compound of the general formula [1] of this invention as an electron-injection material. An anthracene, naphthalene, a phenanthrene, a pyrene, a tetracene, A coronene, a chrysene, a fluorescein, a perylene, a phtalo perylene, Non [naphthalo perylene and peri non, / phtalo peri non, / naphthalo peri] A diphenyl butadiene, a tetrapod phenyl butadiene, a coumarin, an OKISA diazole, Aldazine, screw benzo KISAZORIN, screw styryl, a diamine, a pyrazine, A cyclopentadiene, an oxine, an amino quinoline, an imine, a diphenylethylene, Although there are those derivatives, such as a vinyl anthracene, a diamino carbazole, a pyran, thiopyran, poly methine, merocyanine, an imidazole chelation oxy-NOIDO compound, a Quinacridone, rubrene, and a metal complex compound, it is not limited to these. The above-mentioned material can form a luminous layer with host material also as a doping material, and can form the luminous layer which has a high luminescence property.

[0041] Although low-molecular luminescence compounds, such as a metal complex compound, screw styryl coloring matter, and diamine coloring matter, a conjugate-property macromolecule, etc. are raised also in it, it is not restricted to these. As a metal complex compound, a lithium (8-hydroxy KINORINONATO), Screw (8-hydroxy KINORINONATO) zinc, screw (8-hydroxy KINORINONATO) manganese, Screw (8-hydroxy KINORINONATO) copper, tris (8-hydroxy KINORINONATO) aluminum, A tris (8-hydroxy KINORINONATO) gallium, screw (10-hydroxy BENZO [h] quinolinate) beryllium, Screw (10-hydroxy BENZO [h] quinolinate) zinc, screw (10-hydroxy BENZO [h] quinolinate) magnesium, Tris (10-hydroxy BENZO [h] quinolinate) aluminum, A screw (2-methyl-8-quinolinate) chloro gallium, a screw (2-methyl-8-quinolinate) (o-cresolate) gallium, Screw (2-methyl-8-quinolinate) (1-phenolate) aluminum, A screw (2-methyl-8-quinolinate) (1-phenolate) gallium, Screw (2-methyl-8-quinolinate) (1-naphth RATO) aluminum, A screw (2-methyl-8-quinolinate) (1-naphth RATO) gallium, A screw (2-methyl-8-quinolinate) (1-BIFENORATO) gallium, Although there are screw (2-[2-benzo OKISAZORINATO] phenolate) zinc, screw (2-[2-benzo thia ZORINATO] phenolate) zinc, screw (2-[2-benzo thoria ZORINATO] phenolate) zinc, etc., it is not limited to these. These compounds may be used independently and may mix two or more kinds.

[0042] There is screw styryl coloring matter which used as the connection machine the phenylene group which may have a substituent, a naphthylene machine, a biphenylene machine, an anthra NIREN machine, a pyrenylene machine, a thio phenylene group, the triphenyl amino group, and N-ethyl carbazole machine as screw styryl coloring matter used for luminescent material.

[0043] There is diamine coloring matter which used as the connection machine the phenylene group which may have a substituent, a naphthylene machine, a biphenylene machine, an anthra NIREN machine, a pyrenylene machine, a thio phenylene

group, the triphenyl amino group, and N-ethyl carbazole machine as diamine coloring matter used for luminescent material. These compounds may be used independently and may mix two or more kinds.

[0044] What is necessary is just the bivalent connection machine which consists of 1-200 atoms chosen from C, N, H, O, and S as a connection machine of the conjugate-property macromolecule used for luminescent material and which consists of rational combination chemically. As a concrete connection machine, there are a phenylene group, a naphthylene machine, a biphenylene machine, an anthra NIREN machine, a pyrenylene machine, a thio phenylene group, a triphenyl amino group, an N-ethyl carbazole machine, etc., and a high molecular compound is repeatedly formed by the unit with vinyl combination. As a substituent of these connection machines, the same substituent as the above-mentioned general formula [1] is mentioned. A repeat unit is 10000 or less [2 or more].

[0045] Although the example of representation of this conjugate-property macromolecule is illustrated concretely, it is not limited to the following examples of representation. As a conjugated-system polymer illustrated, poly (p-phenylene), poly (p-phenylenevinylene), Poly (2, 5-dipentyl-p-phenylenevinylene), poly (2, 5-dipentyl-m-phenylenevinylene), Poly (2, 5-dioctyl-p-phenylenevinylene), poly (2, 5-dihexyl oxy--p-phenylenevinylene), Poly (2, 5-dihexyl oxy--m-phenylenevinylene), poly (2, 5-dihexyl thio-p-phenylenevinylene), Poly (2, 5-JIDESHIRU oxy--p-phenylenevinylene) poly (2-methoxy-5-hexyloxy-p-phenylenevinylene), poly (2-methoxy-5-(3'-methyl-butoxy)-p-phenylenevinylene --) Poly (2, 5-thienylene vinylene), poly (the 3-n-octyl -2, 5-thienylene vinylene), poly (1, 4-naphthalene vinylene), poly (9, 10-anthracene vinylene), and those copolymers exist. These compounds may be used independently and may mix two or more kinds.

[0046] The compound which has the capacity to convey an electron hole, as a hole-injection material which can be used for the organic EL element of this invention, has the hole-injection effect which was excellent to a luminous layer or luminescent material, and prevented movement into the electron-injection layer or electron-injection material of an exciton generated by the luminous layer, and was excellent in thin film organization potency is mentioned. Specifically A phthalocyanine, naphthalocyanine, a porphyrin, an OKISA diazole, A triazole, an imidazole, imidazolone, imidazole thione, A pyrazoline, a pyrazolone, a tetrahydro imidazole, an oxazole, An OKISA diazole, a hydrazone, an acyl hydrazone, the poly aryl alkane, a stilbene, a butadiene, a benzidine type triphenylamine, a styryl amine type triphenylamine, a diamine type triphenylamine, etc., Although there are polymeric materials, such as those derivatives and a polyvinyl carbazole, polysilane, and a conductive polymer, etc., it is not limited to these.

[0047] The compound which has the capacity to convey an electron, as an electron-injection material which can be used combining with the compound of the general formula [1] used for the organic EL element of this invention, has the electron-injection effect which was excellent to a luminous layer or luminescent material, and prevented movement into the hole-injection layer or the electron hole transportation material of an exciton generated by the luminous layer, and is excellent in thin film organization potency is mentioned. for example, full -- me -- non, although there are an anthra quinodimethan, diphenoquinone, thiopyran dioxide, an OKISA diazole, thiadiazole, a triazole, perylene tetracarboxylic acid, deflection ORENIRIDEN methane, an anthra quinodimethan, an anthrone, metal complexes, etc. and those derivatives, it is not limited to these Although such electron-injection material can also be used for the same layer as the compound of a general formula [1], the laminating of them can be carried out to the electron-injection layer formed with the compound of a general formula [1], and they can also raise the electron-injection effect. Moreover, sensitization can be carried out by adding electronic acceptance material into hole-injection material, and adding electron-donative material into electron-injection material.

[0048] The hole-injection material used for the organic EL element which used the compound of the general formula [1] of this invention as a luminescent material, combining, luminescent material, doping material, and electron-injection material can use each above-mentioned compound. Moreover, in that case, a suitable compound can be chosen out of the compound of a general formula [1], and it can also be used as an electron-injection material.

[0049] It is also possible to prepare a protective layer on the surface of an element, or to enclose a silicone oil etc., and to protect the whole element for the improvement of stability to the temperature of the organic EL element obtained by this invention, humidity, atmosphere, etc.

[0050] The metal which has a bigger work function than 4eV as a conductive material used for an anode plate is suitable, and organic conductive resin, such as a metal, a metal alloy, ITO, NESA or the poly thiophenes, such as Au, Pt, Ag, Cu, and aluminum, and polypyrrole, is used.

[0051] The metal or metal alloy which has a work function smaller than 4eV as a conductive material used for cathode is suitable. As the material, alloys, such as metals, such as aluminum, In, Mg, Li, and calcium, or Mg/Ag, Li/aluminum, Mg/In, and Mg/aluminum, are mentioned. As long as an anode plate and cathode have the need, they may be formed above the bilayer. An anode plate and cathode are produced by the well-known forming-membranes methods, such as vacuum evaporationo, sputtering, ion plating, and a plasma gun.

[0052] In an organic EL element, in order to make light emit efficiently, as for at least one side, it is desirable among cathode or an anode plate to make it sufficiently transparent in the luminescence wavelength field of an element. Moreover, it is desirable for a substrate to be also transparent. A transparent electrode uses the above-mentioned conductive material, and it sets it up so that a predetermined translucency may secure by methods, such as vacuum evaporationo, sputtering, and the ion plating method. 10% or more of the light transmittance of the electrode by the side of a luminescence side is desirable.

[0053] Although a substrate has mechanical and thermal intensity and should be just transparent, if it illustrates, the thing of the shape of tabulars, such as a glass substrate, polyethylene, a polyether ape phon, polypropylene, and a polyimide, or a film will be raised.

[0054] Formation of each class of the organic EL element of this invention can apply which method of the wet

forming-membranes methods, such as the dry type forming-membranes methods, such as vacuum deposition, sputtering, ion plating, and a plasma gun method, and spin coating, dipping. In the case of a copolymer, after dissolving in a suitable solvent etc., it is desirable to carry out wet membrane formation. Although especially thickness is not limited, it needs to set each class as suitable thickness. If thickness is too thick, in order to obtain a fixed optical output, big applied voltage will be needed and efficiency will become bad. If thickness is too thin, even if a pinhole etc. will occur and it will impress electric field, sufficient luminescence brightness is not obtained. as for the usual thickness, the range of 10 micrometers is suitable from 5nm -- although it comes out, the range of 0.2 micrometers is still more desirable from 10nm

[0055] Although the material which forms each class is dissolved or distributed to solvents, such as chloroform, a tetrahydrofuran, and a dioxane, in the case of the wet forming-membranes method and a thin film is formed, any are sufficient as the solvent. Moreover, also in which organic layer, a suitable resin and a suitable additive are used on a membrane formation disposition for pinhole prevention of a film etc. As such a resin, conductive resin, such as photoconductivity resins, such as insulating resins, such as polystyrene, a polycarbonate, a polyarylate, polyester, a polyamide, urethane, a polysulfone, a polymethylmethacrylate, and poly methyl acrylate, Polly N-vinylcarbazole, and polysilane, the poly thiophene, and polypyrrole, can be mentioned.

[0056] As mentioned above, when the compound of a general formula [1] was used for the organic EL element of this invention and it was used as an electron-injection material, the injection efficiency of the electron from electronic transport capacity and an electronic cathode side was raised, and when it was used as a luminescent material, luminous efficiency and luminescence brightness were able to be made high. Moreover, since it was very stable as an element since the electronic transportability in the thin film layer of an element and electron-injection efficiency are high, and high luminescence brightness was obtained with low drive current as a result, the life which was a big problem to the former was also able to be reduced sharply.

[0057] The organic EL element of this invention can consider application as a flat-panel display and flat-surface emitters, such as a flat TV, to the light sources, such as the light sources, such as a copying machine and a printer, a liquid crystal display, and instruments, the plotting board, a beacon light, etc., and the industrial value is very large.

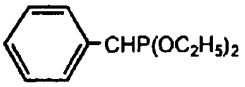
[0058]

[Example] Hereafter, this invention is further explained to a detail based on an example.

Into the synthetic method flask of a compound (1), 2-(2-hydroxy-3-benzaldehyde) benzo oxazole 2.1g and ethanol 200ml are added, and it is made to stir and dissolve at 65 degrees C. After dissolving, 1.0g of acetic-anhydride zinc was added, after the methanol washed the crystal which stirred for 3 hours and deposited at 65 degrees C the ** exception, it was made to dry, and 1.9g yellow white powder was obtained. It was a screw [2-(2-hydroxy-3-benzaldehyde) benzo oxazole] zinc complex as a result of the elemental analysis of this powder, molecular weight analysis, and the NMR analysis of a spectrum. Furthermore, 4.2g [of phosphoric ester of ** 5], 5.2g [of the above-mentioned screw [2-(2-hydroxy-3-benzaldehyde) benzo oxazole] zinc complexes], and sodium-ethylate 2.9g and ethanol 75ml are put in into a flask, and it stirs under heating reflux for 1 hour. After cooling, after washing and filtering in the order of ethanol and a purified water, it recrystallized with ethyl acetate and 4.1g fine yellow powder was obtained. It checked that it was a compound (1) as a result of the elemental analysis of this powder, molecular weight analysis, and the NMR analysis of a spectrum.

[0059]

[Formula 5]



[0060] The electrical property and luminescence property (luminescence brightness, the maximum luminescence brightness) of a measuring method organic EL element of an organic EL element impress a direct current or alternating voltage to an organic EL element, and measure the amount of current and luminescence brightness which were produced. [of a luminescence property] A constant current power supply or a constant voltage power supply is used, and a power supply measures the produced current with an ammeter. Luminescence brightness measures produced luminescence by the luminance meter. The luminescence brightness of the organic EL element of this invention was measured by LS-100 by Minolta Camera Co., Ltd. Luminous efficiency was computed by the method indicated by (the "organic EL-element development-strategy" 207-page science forum company edited by next-generation display device study group). In this example, the glass with an ITO electrode of the surface-electrical-resistance value 10 (omega/**) was used. The example at the time of using an organic EL-element material of this invention as a luminescent material is shown below.

On the glass plate with an ITO electrode washed example 1, they are N, N'-(4-methylphenyl)-N, and N'. -(4-n-buthylphenyl)- The phenanthrene -9 and 10-diamine were dissolved in the tetrahydrofuran, and the hole-injection layer of 40nm of thickness was obtained by spin coating. subsequently, vacuum deposition of the compound (3) was carried out, the luminous layer of 40nm of thickness was created, vapor codeposition of magnesium and the silver was carried out by 10:1, it came out, the cathode of 100nm of thickness was formed, and the organic EL element was obtained A luminous layer and cathode deposited substrate temperature at the room temperature in the vacuum of 10-6Torr. As for this element, luminescence of the luminescence brightness 320 (cd/m2), the maximum luminescence brightness 28,000 (cd/m2), and the luminous efficiency 2.3 (lm/W) in the time of 5V impression was obtained by direct-current-voltage 5V. Next, 1/2 or more luminescence brightness of initial brightness was able to be held for 10,000 hours or more as a result of life test which made this element emit light continuously with the current density of 3 (mA/cm2).

[0061] the glass-plate top with an ITO electrode washed example 2-27 -- N and N' - diphenyl-N and N' - dinaphthyl -1 and 1' -- the - biphenyl -4 and 4' -- vacuum deposition of the - diamine was carried out, and the hole-injection layer of 40nm of thickness was obtained Subsequently, vacuum deposition of the compound shown in Table 2 was carried out, the luminous layer of 40nm of thickness was created, vapor codeposition of magnesium and the silver was carried out by 10:1, the cathode of 100nm of thickness was formed, and the organic EL element was obtained. A hole-injection layer, a luminous layer, and cathode deposited substrate temperature at the room temperature in the vacuum of 10-6Torr. This element showed the luminescence property shown in Table 2. Next, 1/2 or more luminescence brightness of initial brightness was able to be held for 10,000 hours or more as a result of life test which made this element emit light continuously with the current density of 3 (mA/cm2). This result shows that an organic EL-element material of this invention is an outstanding electron-injection nature luminescent material.

[0062]

[Table 2]

実施例	化合物	発光輝度 (cd/m²)	最大発光輝度 (cd/m²)	発光効率 (lm/W)
2	(1)	410	31,000	2.3
3	(4)	400	33,000	2.5
4	(5)	410	30,000	2.8
5	(8)	510	32,000	3.0
6	(9)	500	31,000	3.1
7	(10)	480	31,000	3.1
8	(12)	400	41,000	2.8
9	(14)	420	32,000	2.7
10	(20)	410	30,000	3.0
11	(23)	360	31,000	3.0
12	(25)	480	32,000	3.2
13	(26)	510	36,000	4.1
14	(31)	490	37,000	3.7
15	(35)	410	37,000	3.5
16	(38)	380	32,000	2.5
17	(42)	420	35,000	2.9
18	(44)	400	35,000	2.8
19	(48)	430	38,000	3.5
20	(54)	450	46,000	3.2
21	(55)	440	42,000	3.8
22	(58)	450	37,000	3.5
23	(57)	420	44,000	3.4
24	(58)	460	43,000	3.7
25	(59)	420	39,000	3.3
26	(60)	380	35,000	3.0
27	(61)	320	29,000	3.1

発光輝度と発光効率は直流5（V）印加時の値を示す。

[0063] a glass plate with an example 28ITO electrode, N, and N' - diphenyl-N and N' - dinaphthyl -1 and 1' -- the - biphenyl -4 and 4' -- the organic EL element was produced by the same method as an example 2 except carrying out vacuum deposition of the non-metal phthalocyanine, and preparing the hole-injection layer of 5nm of thickness between - diamines As for this element, luminescence of the luminescence brightness 740 (cd/m2) of direct-current-voltage 5V, the maximum luminescence brightness 33,000 (cd/m2), and the luminous efficiency 3.3 (lm/W) in the time of 5V impression was obtained. Next, 1/2 or more luminescence brightness of initial brightness was held for 20,000 hours or more as a result of life test which made this element emit light continuously with the current density of 3 (mA/cm2). Its luminescence brightness of direct-current-voltage 5V is high, and in case the element of this example is driven by the low battery, it is advantageous.

[0064] The organic EL element was produced by the same method as an example 2 except carrying out vapor codeposition of aluminum and the lithium for example 29 cathode by 100:2. As for this element, luminescence of the luminescence brightness 670 (cd/m2) of direct-current-voltage 5V, the maximum luminescence brightness 40,000 (cd/m2), and the luminous efficiency 3.7 (lm/W) in the time of 5V impression was obtained. Next, 1/2 or more luminescence brightness of initial brightness was held for 20,000 hours or more as a result of life test which made this element emit light continuously with the current density of 3 (mA/cm2).

[0065] As example of comparison 1 luminescent material, the organic EL element was produced by the same method as an example 2 except using a tris (8-hydroxyquinoline) aluminum complex. As for this element, luminescence of the luminescence brightness 190 (cd/m2) of direct-current-voltage 5V, the maximum luminescence brightness 14,000 (cd/m2), and the luminous efficiency 1.2 (lm/W) in the time of 5V impression was obtained.

[0066] Next, the example at the time of using an organic EL-element material of this invention as an electron-injection material is shown below.

the glass-plate top with an ITO electrode washed example 30 -- N and N' - diphenyl-N and N' - dinaphthyl -1 and 1' -- the - biphenyl -4 and 4' -- vacuum deposition of the - diamine was carried out, and the hole-injection layer of 40nm of thickness was obtained Subsequently, vacuum deposition of a tris (8-hydroxyquinoline) aluminum complex and the Quinacridone was carried out by the weight ratio of 50:1, the luminous layer of 40nm of thickness was created, vacuum deposition of the compound (15) was carried out on it, the electron-injection layer of 30nm of thickness was created, the electrode of 100nm of thickness was formed with the alloy which mixed aluminum and the lithium by 100:1, and the organic EL element was obtained. The

hole-injection layer, the luminous layer, and the electron-injection layer were deposited under the conditions of a substrate temperature room temperature in the vacuum of 10-6Torr. As for this element, luminescence of the luminescence brightness 1200 (cd/m2), the maximum luminescence brightness 110,000 (cd/m2), and the luminous efficiency 8.9 (lm/W) in the time of 5V impression was obtained by direct-current-voltage 5V. Next, 1/2 or more luminescence brightness of initial brightness was held for 20,000 hours or more as a result of life test which made this element emit light continuously with the current density of 3 (mA/cm2).

[0067] the glass-plate top with an ITO electrode washed example 31 -- N and N' - diphenyl-N and N' - dinaphthyl -1 and 1' -- the - biphenyl -4 and 4' -- vacuum deposition of the - diamine was carried out, and the hole-injection layer of 40nm of thickness was obtained Subsequently, vacuum deposition of the compound (26) was carried out, the luminous layer of 40nm of thickness was created, vacuum deposition of the compound (31) was carried out on it, the electron-injection layer of 30nm of thickness was created, the electrode of 100nm of thickness was formed with the alloy which mixed aluminum and the lithium by 100:1, and the organic EL element was obtained. The hole-injection layer, the luminous layer, and the electron-injection layer were deposited under the conditions of a substrate temperature room temperature in the vacuum of 10-6Torr. As for this element, luminescence of the luminescence brightness 710 (cd/m2), the maximum luminescence brightness 41,000 (cd/m2), and the luminous efficiency 4.2 (lm/W) in the time of 5V impression was obtained by direct-current-voltage 5V. Next, 1/2 or more luminescence brightness of initial brightness was held for 10,000 hours or more as a result of life test which made this element emit light continuously with the current density of 3 (mA/cm2).

[0068] Example 32 poly (2, 5-dipentyl-p-phenylenevinylene) was dissolved in the tetrahydrofuran, and the organic EL element was produced by the same method as an example 2 except obtaining the luminous layer of 40nm of thickness by spin coating. As for this element, luminescence of the luminescence brightness 290 (cd/m2), the maximum luminescence brightness 31,000 (cd/m2), and the luminous efficiency 2.5 (lm/W) in the time of 5V impression was obtained by direct-current-voltage 5V. Next, 1/2 or more luminescence brightness of initial brightness was held for 10,000 hours or more as a result of life test which made this element emit light continuously with the current density of 3 (mA/cm2).

[0069] The organic EL element was produced by the same method as an example 31 except replacing with a glass plate with an example 33ITO electrode, and using the PES film substrate with an ITO electrode of the washed surface-electrical-resistance value 10 (omega/**). As for this element, luminescence of the luminescence brightness 690 (cd/m2), the maximum luminescence brightness 43,000 (cd/m2), and the luminous efficiency 5.8 (lm/W) in the time of 5V impression was obtained by direct-current-voltage 5V. Next, 1/2 or more luminescence brightness of initial brightness was held for 10,000 hours or more as a result of life test which made this element emit light continuously with the current density of 3 (mA/cm2).

[0070] example of comparison 2 compound (31) -- replacing with -- 2-(4'-tert-buthylphenyl)-5-(4"-biphenyl)- the organic EL element was produced by the same method as an example 31 except using 1, 3, and 4-OKISA diazole As for this element, luminescence of the wave height brightness 220 (cd/m2), the maximum luminescence brightness 12,000 (cd/m2), and the luminous efficiency 1.1 (lm/W) in the time of 5V impression was obtained by direct-current-voltage 5V. Next, it fell to 1/2 or less luminescence brightness of initial brightness in 340 hours as a result of life test which made this element emit light continuously with the current density of 3 (mA/cm2).

[0071] It replaced with example of comparison 3 compound (26), and the organic EL element was produced by the same method as an example 31 except using a tris (8-hydroxyquinoline) aluminum complex. As for this element, luminescence of the luminescence brightness 450 (cd/m2), the maximum luminescence brightness 24,000 (cd/m2), and the luminous efficiency 2.1 (lm/W) in the time of 5V impression was obtained by direct-current-voltage 5V. Next, it fell to 1/2 or less luminescence brightness of initial brightness in 1,500 hours as a result of life test which made this element emit light continuously with the current density of 3 (mA/cm2).

[0072] The organic EL element of this invention attains improvement in luminous efficiency and luminescence brightness, and reinforcement, and does not limit the element production methods used collectively, such as luminescent material, doping material, hole-injection material, electron-injection material, a sensitizer, a resin, and an electrode material.

[0073]

[Effect of the Invention] By this invention, when the outstanding electronic transport capacity and the outstanding injection efficiency from cathode used a good compound for an electron-injection layer, compared with the former, it is high luminous efficiency and high brightness, and the long lasting organic EL element was able to be obtained. Since there is little condensation of the compound in the formed thin film, this is considered because degradation of an element was prevented and the stable luminescence property and the stable electron-injection property were acquired.

[Translation done.]